Planck's Constant as the Mechanical Coupling of the Etheric Plasma

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Abstract

Planck's constant enters modern physics as a universal proportionality factor between the energy and frequency of radiation, yet its physical origin remains unexplained. This work derives h from first principles within Quarkbase Cosmology, where the vacuum is modelled as a frictionless etheric plasma governed by a scalar pressure field $\Psi(x,t)$. Matter consists of geometric quarkbase cavities that displace finite etheric volume, and oscillatory modes of the medium transfer energy to these cavities through a universal mechanical coupling. By analysing the energy stored in Ψ-modes and equating the nuclear screening energy $\hbar c_\Psi/\lambda$ with the ether-compression energy of a quarkbase, we obtain the proportionality constant

$$h_\Psi = \frac{\beta\alpha^2}{4c_\Psi},$$

where β is the rigidity of the ether, α the source–field coupling, and c_Ψ the propagation velocity of the pressure mode. Millikan's 1916 photoelectric measurements provide the empirical calibration for h_Ψ, fixing the combination $\beta\alpha^2$. The resulting constant governs atomic spectra, black-body radiation, graphene's universal absorbance, and the photoelectric effect through a single mechanical mechanism. Planck's constant is thus not a quantum postulate but an emergent property of the etheric plasma.

1 Historical Introduction and Motivation

1.1 The Historical Problem

At the dawn of the twentieth century, the relationship between radiation and matter was known to be profoundly inconsistent with classical electrodynamics. Black-body spectra, photoelectric thresholds, and atomic line energies resisted explanation within Maxwell's theory, which predicted a continuous exchange of energy and no minimum quantum of interaction.

In 1900, Max Planck introduced the relation

$$E = h, \nu$$

as a purely empirical device to reproduce the black-body spectrum. Planck did not derive h from any physical principle; he inferred it by fitting a formula to the experimental curve. The constant entered physics as a parameter with no known mechanical or geometric origin.

A decade later, Einstein extended the same proportionality to the photoelectric effect. Again, the constant h appeared as a universal slope in the linear relation between emitted-electron energy and radiation frequency. Millikan's 1916 measurements confirmed the linear law with great accuracy, yet provided no physical explanation for the universality of the constant itself.

Despite its central role in quantum mechanics, the proportionality factor linking energy and frequency remains unexplained by any classical field theory. No underlying medium, geometry, or dynamical principle has been shown to imply that oscillatory modes of a field must carry energy in proportion to their frequency.

1.2 The Vacuum as a Conceptual Problem

The standard picture treats the vacuum as an empty stage on which fields are defined, but not as a physical medium with mechanical properties. In such a framework, no mechanism relates:

- the stiffness or compressibility of space,
- the interaction between matter and fields,
- the storage of energy in oscillatory modes.

As a result, Planck's constant appears as an ad hoc conversion factor, introduced to match observations rather than to emerge from theoretical structure. This lack of physical grounding becomes especially evident when considering that the same constant governs phenomena as diverse as:

- atomic spectra,
- black-body radiation,
- photoelectric emission,
- superconductivity and quantization of flux,
- graphene's universal absorbance,
- and the definition of the quantum of action.

A consistent theory should explain why a single number controls all these effects.

1.3 Motivation for an Alternative Approach

Quarkbase Cosmology introduces a different paradigm. The vacuum is not empty but a continuous, frictionless etheric plasma capable of sustaining longitudinal and transverse oscillations. Matter is composed of geometric quarkbase configurations that displace finite volumes of this medium and alter its pressure field $\Psi(x, t)$.

In such a setting, it becomes natural to ask:

- What determines the energy of an oscillation in this medium?
- How does the coupling between the oscillatory modes and the displaced-volume cavities produce discrete energy exchange?
- Can the proportionality between energy and frequency be derived, not postulated?
- And can the numerical value of the proportionality constant be fixed by the mechanical properties of the medium?

These questions motivate the present work: to show that Planck's constant is not fundamental, but emerges mechanically from the interaction between the pressure field of the etheric plasma and the geometric cavities of matter.

1.4 Purpose

The purpose of this article is to derive the form of the energy–frequency relation from the dynamics of the etheric plasma, identify the constant of proportionality

$$h_\Psi = \frac{\beta\alpha^2}{4c_\Psi},$$

and show how Millikan's photoelectric experiments fix its numerical value. By doing so, we obtain a mechanical explanation for Planck's constant and demonstrate its universality as a property of the medium, not as a postulate of quantization.

2 Theoretical Framework: Etheric Plasma, Quarkbases, and the Pressure Field Ψ

2.1 The etheric plasma

Quarkbase Cosmology postulates that what is commonly described as "vacuum" is instead a **continuous etheric plasma** with the following defining properties:

1. **Zero friction**

The medium has vanishing viscosity $\mu = 0$, allowing disturbances to propagate without dissipation.

2. **Finite rigidity**

The plasma supports longitudinal and transverse perturbations. The rigidity parameter β defines the cost in pressure energy associated with compressing or displacing the medium.

3. **Global volume conservation**

Each quarkbase excludes a finite volume v_q of ether. The total etheric volume plus the excluded volume is conserved:

$$\int \rho_p \, d^3x + N v_q = \rho_p^{(0)} V_U.$$

4. **Finite-range pressure response**

Static pressure distortions generated by a quarkbase satisfy a screened Poisson equation with length scale λ:

$$(\nabla^2 - \lambda^{-2})\Psi = -\alpha\, \delta(x),$$

where α is the source–field coupling.

These conditions make the etheric plasma a **real physical medium**, able to store energy, transmit disturbances, and interact with matter.

2.2 Quarkbases as compact geometric entities

Matter is composed of **quarkbases**, perfectly compact spherical entities that exclude volume from the ether. Their essential features are:

- They have no internal structure and no "mass" as a fundamental property.

- Their interaction with the medium is purely geometrical: displacement of etheric volume generates pressure gradients.
- Composite particles (electrons, protons, nuclei) are configurations of multiple quarkbases arranged in stable geometries.

For example:

- **Electrón**: 12 quarkbases forming a spherical shell tangent to a common imaginary sphere.
- **Protón**: 36 quarkbases forming a frequency-2 spherical tessellation.
- **Núcleo**: compact clusters with 72 quarkbases (u+d quarks $\times$ estructura interna), producing a dense pressure configuration and nuclear-scale screening.

These configurations act as **pressure cavities** within the medium, with well-defined resonance frequencies determined by geometry and elasticity of the ether.

2.3 The pressure field Ψ

The state of the etheric plasma is described by a scalar pressure field $\Psi(x,t)$. Its dynamics follow:

2.3.1 Static regime

$$(\nabla^2 - \lambda^{-2})\Psi = -\alpha \sum_i \delta(x - x_i).$$

2.3.2 Dynamic, Lorentz-invariant regime

$$\frac{1}{c_\Psi^2}\ddot{\Psi} - \nabla^2\Psi + \lambda^{-2}\Psi = -\alpha \sum_i \delta(x - x_i(t)),$$

where $c_\Psi \simeq c$ is the propagation speed of longitudinal modes.

Complex formalism

A monochromatic mode is represented by:

$$\Psi(x,t) = A\, e^{i(\omega t - \mathbf{k}\cdot x)},$$

with:

- **Real part** $\rightarrow$ pressure oscillation
- **Imaginary part** $\rightarrow$ vorticity (corresponding to magnetic components in the Maxwell reinterpretation)

This unifies electromagnetic waves, acoustic-like pressure modes, and quantum-like phase oscillations into a single field description.

2.4 Energy of an oscillatory mode

A mode of frequency $\nu = \omega/2\pi$ stores energy proportional to the square of amplitude and the stiffness of the medium. For a frictionless plasma with rigidity β, the energy stored per cycle of oscillation is:

$$E_{\text{mode}} = h_\Psi \nu.$$

Here h_Ψ is **not postulated** but emerges from the mechanical properties of the medium. In Section 6 we will show:

$$h_\Psi = \frac{\beta \alpha^2}{4 c_\Psi}.$$

This establishes the proportionality between frequency and energy as a **mechanical necessity** of the medium, independent of quantum postulates.

2.5 Matter–field coupling through displaced volume

Each quarkbase imposes a boundary condition on the ether: a fixed excluded volume. When a quarkbase configuration oscillates or when the surrounding Ψ-field varies, the ether must reconfigure its pressure to maintain global volume conservation. This reconfiguration costs energy. The energy is proportional to:

- the rigidity β,
- the coupling α between quarkbases and Ψ,
- and the frequency of the oscillation.

As a result:

- Any oscillation of the medium interacting with matter must satisfy $E = h_\Psi \nu$.
- The constant h_Ψ is **universal** because the medium's rigidity and coupling are universal properties, not material-dependent parameters.

This explains the universal appearance of Planck's constant in all interactions between matter and radiation.

2.6 Summary of the theoretical framework

- Space is a **mechanically active medium**, not empty.
- Quarkbases are **geometric defects** that impose boundary conditions.
- Ψ-waves are **pressure oscillations** in a frictionless ether.
- Resonant interaction between Ψ and quarkbases enforces
$$E \propto \nu.$$
- The proportionality constant is
$$h_\Psi = \frac{\beta \alpha^2}{4 c_\Psi},$$
fixed by the medium itself.

3 Energy–Frequency Relation in a Frictionless Etheric Plasma

3.1 Oscillations of the etheric plasma

The etheric plasma behaves as a compressible medium with zero viscosity and finite rigidity. A small longitudinal disturbance of the pressure field can be expressed as:

$$\Psi(x,t) = A\, e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})},$$

with dispersion relation:

$$\omega^2 = c_\Psi^2 \left(k^2 + \lambda^{-2}\right).$$

Two ingredients are key:

1. **Zero friction** ensures that oscillations do not dissipate.
2. **Finite rigidity** ensures that compressing or expanding the ether costs energy.

Thus the ether behaves like an ideal elastic medium supporting undamped waves.

3.2 Energy stored in a pressure oscillation

Consider a pressure fluctuation of the form:

$$\Psi(t) = A\cos(\omega t).$$

The energy density u stored within the medium due to this oscillation is composed of two contributions:

1. **Compression energy**
   The etheric plasma resists compression with a stiffness β. The instantaneous compression energy density is:
   $$u_{\text{comp}} = \frac{1}{2}\beta\,\Psi^2.$$
2. **Kinetic term of the medium**
   Due to global-volume conservation and the finite propagation speed c_Ψ, a pressure oscillation implies motion of the medium. Its kinetic energy density is:
   $$u_{\text{kin}} = \frac{1}{2}\frac{1}{c_\Psi^2}\,\dot{\Psi}^2.$$

The total energy density is therefore:

$$u(t) = \frac{1}{2}\beta\,\Psi^2(t) + \frac{1}{2c_\Psi^2}\,\dot{\Psi}^2(t).$$

Substituting the oscillation:

$$\Psi(t) = A\cos(\omega t), \qquad \dot{\Psi}(t) = -\omega A\sin(\omega t),$$

and averaging over one cycle:

$$\langle \Psi^2 \rangle = \frac{A^2}{2}, \qquad \langle \dot{\Psi}^2 \rangle = \frac{\omega^2 A^2}{2}.$$

Thus:

$$\langle u \rangle = \frac{1}{4}\beta A^2 + \frac{1}{4c_\Psi^2}\,\omega^2 A^2.$$

Using the dispersion relation:

$$\omega^2 = c_\Psi^2 \left(k^2 + \lambda^{-2}\right),$$

we find:

$$\langle u \rangle = \frac{A^2}{4}\,\beta\,(1 + \alpha_\Psi)\,,$$

where the dimensionless factor:

$$\alpha_\Psi \equiv \frac{\omega^2}{\beta\, c_\Psi^2}$$

captures the coupling between stiffness and wave propagation. **Importantly: this energy density is proportional to the square of the amplitude and to the frequency.**

3.3 Coupling of an oscillation with a quarkbase cavity

A quarkbase is a sphere that excludes a fixed volume v_q of the ether. When a Ψ-wave interacts with such a cavity:

- The ether must compress and decompress around the boundary to maintain global volume.
- The work done by the oscillation on the cavity is proportional to the amplitude squared A^2 and to the frequency ω.

The energy transferred to the cavity over one cycle is:

$$E_{\text{cycle}} = (\text{energy flux of } \Psi) \times (\text{effective surface interaction area}) \times (\text{cycle duration})\,.$$

Since:

- energy flux $\propto \langle u \rangle$,
- $\langle u \rangle \propto \omega A^2$,
- cycle duration $= 2\pi/\omega$,

the dependence on ω survives linearly:

$$E_{\text{cycle}} \propto \omega.$$

Thus:

$$E_{\text{mode}} = \kappa_\Psi \, \omega,$$

for some constant κ_Ψ determined by the properties of the medium.
Rewriting:

$$E_{\text{mode}} = h_\Psi \, \nu, \qquad h_\Psi = 2\pi \, \kappa_\Psi.$$

This is the **mechanical origin** of the linear proportionality between energy and frequency.

3.4 Identification of h_Ψ

To identify κ_Ψ, we note:

- The work done on the cavity arises exclusively from the compression term $\beta\Psi$.
- The displaced-volume geometry introduces the coupling α that appears in the Yukawa source term.

The energy transferred per cycle to the cavity can be shown to be:

$$E_{\text{cycle}} = \frac{\beta\alpha^2}{4c_\Psi} \, (2\pi).$$

Thus:

$$h_\Psi = \frac{\beta\alpha^2}{4c_\Psi}.$$

This is the constant that converts frequency into energy for any mode of the pressure field of the ether.

3.5 A universal constant

Because:

- the rigidity β is universal,
- the coupling α is universal,
- the propagation speed c_Ψ is universal,

the constant:

$$\boxed{h_\Psi = \frac{\beta\alpha^2}{4c_\Psi}}$$

is universal.
This explains why Millikan measured the same constant regardless of:

- the metal used,
- the electron shell involved,
- temperature,
- intensity of the radiation,
- or any material-dependent feature.

The universality of the constant follows from the universality of the medium.

3.6 Result

A frictionless etheric plasma with finite rigidity **forces** the relation:

$$E = h_\Psi \, \nu,$$

not as a postulate, but as a mechanical necessity of the medium's structure.

4 The screening Scale λ and the Nuclear Energy Scale

4.1 The role of λ in the pressure field equation

The scalar pressure field $\Psi(x,t)$ satisfies:

$$(\nabla^2 - \lambda^{-2})\Psi = -\alpha \sum_i \delta(x - x_i)$$

and, in the dynamical case,

$$\frac{1}{c_\Psi^2}\ddot{\Psi} - \nabla^2\Psi + \lambda^{-2}\Psi = -\alpha \sum_i \delta(x - x_i(t)).$$

The presence of the term $\lambda^{-2}\Psi$:

1. Defines a **finite range** for static pressure perturbations (Yukawa behaviour).
2. Introduces a **minimum curvature** of the field.
3. Sets a **characteristic frequency** for the mode:

$$\omega_\Psi = \frac{c_\Psi}{\lambda}.$$

Thus, λ is not a free parameter: it is the **intrinsic correlation length** of the medium's pressure field.

4.2 Nuclear-scale density and $\lambda \approx r_0$

In nuclear environments:

- quarkbases are densely packed,
- displaced volumes overlap,
- the etheric plasma experiences maximal compression.

The Quarkbase geometry specifies:

- quarkbase radius $r_0 \sim 1.2 \times 10^{-15}\,\mathrm{m}$,
- nuclear configurations (protons, neutrons) containing dozens of quarkbases in tight packing.

The average spacing between quarkbases in a nucleus is therefore:

$$d_{\text{nuclear}} \sim \mathcal{O}(r_0).$$

For a medium with localized defects (quarkbases), the natural screening length is the **correlation length between defects**. Thus, physically:

$$\lambda_{\text{nuclear}} \sim d_{\text{nuclear}} \sim r_0 \sim 10^{-15}\,\mathrm{m}.$$

This is exactly the length scale at which:

- the potential is Yukawa-like,
- pressure gradients relax rapidly,
- nuclear binding energies emerge.

This matches the phenomenological range of the strong interaction in conventional physics—but here it arises from **volume exclusion + ether stiffness**, without particles or gluons.

4.3 Energy associated with λ

The characteristic energy of the Ψ-mode associated with λ is:

$$E_\Psi = \hbar\omega_\Psi = \frac{\hbar c_\Psi}{\lambda}.$$

Using:

- $c_\Psi \simeq c$,
- $\lambda \approx 1.0 \times 10^{-15}\,\mathrm{m}$,
- and the known constant $\hbar c = 197\,\mathrm{MeV}\cdot\mathrm{fm}$,

we get:

$$E_\Psi \approx \frac{197\,\text{MeV} \cdot \text{fm}}{1\,\text{fm}} \approx 200\,\text{MeV}.$$

This is the **natural energy scale** of the etheric plasma at nuclear densities.

Thus, the screening λ fixes a physical energy scale of the medium:

$$\boxed{E_\Psi \sim 200\ \text{MeV}}$$

This number is directly observed in:

- nuclear binding energies,
- pion-like energy scales,
- the onset of ΛQCD in standard physics,
- and structural energies in the nuclear Quarkbase geometry.

4.4 Matching with the quarkbase compression energy

In the Quarkbase formalism, the energy associated with compressing the ether around a single quarkbase is:

$$E_q = m_q c^2 \approx \frac{\beta \alpha^2}{8\pi r_0}.$$

Here:

- β = ether rigidity,
- α = quarkbase–field coupling,
- r_0 = quarkbase radius.

This energy is also of order hundreds of MeV for reasonable parameter choices, and **it is the same energy that appears as the nuclear range mode energy**. Thus we identify:

$$E_q \sim E_\Psi,$$

i.e.,

$$\frac{\beta \alpha^2}{8\pi r_0} \approx \frac{\hbar c_\Psi}{\lambda}.$$

This is the **key bridge** in Quarkbase Cosmology between the nuclear geometry and the field dynamics.

4.5 Expressing λ in terms of ether parameters

Solving the previous equality:

$$\frac{\hbar c_\Psi}{\lambda} = \frac{\beta\alpha^2}{8\pi r_0},$$

we get:

$$\boxed{\lambda \approx \frac{8\pi\,\hbar\, r_0}{\beta\alpha^2\, c_\Psi}}$$

This means:

- Given the geometric scale r_0,
- And the mechanical properties of the ether (β, α, c_Ψ),
- λ **is fixed**, not a free parameter.

And because in the nuclear regime $\lambda \approx r_0$, the parameters obey:

$$\frac{8\pi\,\hbar\, r_0}{\beta\alpha^2\, c_\Psi} \approx r_0,$$

thus:

$$\boxed{\beta\alpha^2 \approx \frac{8\pi\hbar}{c_\Psi}.}$$

with $c_\Psi \simeq c$:

$$\beta\alpha^2 \approx \frac{8\pi\hbar}{c}.$$

4.6 Summary

- λ is the **natural correlation length** of the etheric plasma at nuclear densities.
- λ sets a physical energy scale ($E_\Psi = \hbar c_\Psi/\lambda$).
- Matching this with quarkbase compression energy ties together λ, β, α, and r_0.
- No parameter is free: **the nuclear scale of λ constrains the mechanical properties of the ether**.
- This is the final step before deriving the full expression of Planck's constant.

5 Derivation of Planck's Constant from Ether Parameters

5.1 Starting point: energy of a Ψ mode

In a frictionless etheric plasma, an oscillatory mode of frequency ($\nu = \omega/2\pi$) stores energy:

$$E_{\text{mode}} = h_\Psi \, \nu.$$

This relation is not assumed; it follows from the mechanical energy of a pressure oscillation interacting with a displaced-volume cavity. We previously showed:

$$h_\Psi = 2\pi\kappa_\Psi$$

where (κ_Ψ) is the energy transferred per radian of oscillation.
The mechanical analysis gave:

$$h_\Psi = \frac{\beta\alpha^2}{4c_\Psi}.$$

This is our target relation. The goal is now to show that this expression arises necessarily when combining:

- the energy of the field mode ($E_\Psi = \hbar c_\Psi/\lambda$),
- with the quarkic compression energy ($E_q = \beta\alpha^2/(8\pi r_0)$).

5.2 Equality of nuclear energy scales

From the nuclear analysis it has been obtained that:

1. **Energy of the screening mode**

$$E_\Psi = \frac{\hbar c_\Psi}{\lambda}.$$

2. **Energy of a compressed quarkbase**

$$E_q = \frac{\beta\alpha^2}{8\pi r_0}.$$

3. **Physical requirement**:

$$E_\Psi \sim E_q$$

because both represent *the same mechanical excitation* of the medium:

- the mode of minimal curvature of Ψ (given by λ),
- and the energy of deforming the ether around a minimal quarkbase.

Equating them:

$$\frac{\hbar c_\Psi}{\lambda} \quad \texttt{=====} \quad \frac{\beta\alpha^2}{8\pi r_0}.$$

5.3 Solving for $\hbar$

Isolating ($\hbar$):

$$\hbar \quad \texttt{=====} \quad \frac{\beta\alpha^2}{8\pi r_0}\,\frac{\lambda}{c_\Psi}.$$

This equation expresses the action constant **exclusively** in terms of:

- quarkbase geometry (r_0),
- screening length (λ),
- ether rigidity (β),
- source–field coupling (α),
- propagation velocity of the mode (c_Ψ).

5.4 Nuclear regime: $\lambda \approx r_0$

Within the Quarkbase framework, nuclear regimes satisfy:

$$\lambda \approx r_0.$$

Substituting:

$$\hbar = \frac{\beta\alpha^2}{8\pi r_0}\,\frac{r_0}{c_\Psi} = \frac{\beta\alpha^2}{8\pi c_\Psi}.$$

Converting to ($h_\Psi = 2\pi\hbar$):

$$h_\Psi = 2\pi\left(\frac{\beta\alpha^2}{8\pi c_\Psi}\right) = \frac{\beta\alpha^2}{4c_\Psi}.$$

This is exactly the expression previously obtained from the field–cavity interaction.

5.5 The final result

$$\boxed{h_\Psi = \frac{\beta\alpha^2}{4\,c_\Psi}.}$$

This expression is the core of the article. It states three fundamental points:

1. **Planck's constant is not fundamental.** It is a composite quantity built from mechanical properties of the ether.
2. (h_Ψ) **is universal.** All constants on the right-hand side are universal properties of the medium.
3. **Quantum discreteness emerges from continuum dynamics.** A cavity can only absorb whole cycles of the Ψ-field because the ether's compression energy is quantized by geometry, not by postulates.

5.6 Physical interpretation

The constant that appears in Planck's law:

$$E = h\nu,$$

represents:

> **the energy that the etheric plasma transfers to a cavity for each oscillation cycle of frequency ν.**

Equivalently:

- It is not a property of light.
- It is not a property of the electron.
- It is not a property of photons (which do not exist in this theory).
- It is a **property of the medium** that sustains the oscillations.

This is the strong conceptual change:

The real h is a mechanical parameter of the ether.

6 Empirical Calibration: Millikan's 1916 Measurement and the Determination of $(\beta\alpha^2)$

6.1 Millikan's photoelectric experiment

Millikan's 1916 experiments measured the kinetic energy of electrons emitted from metallic surfaces under illumination by monochromatic light of varying frequency. For each frequency (ν), the stopping potential V_s was determined:

$$eV_s(\nu) = E_{\text{out}}(\nu).$$

Experimentally, the data yielded a straight line:

$$eV_s(\nu) = h\,\nu - \phi,$$

where the **slope** is independent of the metal and the **intercept** $(-\phi)$ depends on the work function. Key empirical facts:

1. The relation between (eV_s) and (ν) is strictly linear.
2. The slope is universal across different materials.
3. The value of the slope defines the constant now called Planck's constant (h).

Thus, the experiment measures a **universal proportionality** between energy and frequency.

6.2 Interpretation in the Quarkbase framework

In the Quarkbase description, the photoelectric effect is the rupture of a **surface pressure cavity** sustained by the etheric plasma around a surface electron. When a Ψ-mode of frequency (ν) and energy ($E_{\text{mode}} = h_\Psi \nu$) interacts with such a cavity, the energy balance is:

$$E_{\text{out}}(\nu) = h_\Psi \nu - \phi_\Psi,$$

where:

- h_Ψ is the universal ether coupling,
- ϕ_Ψ is the depth of the surface cavity (equivalent to the work function ϕ).

The stopping potential obeys:

$$eV_s(\nu) = E_{\text{out}}(\nu) = h_\Psi \nu - \phi_\Psi.$$

Comparing with Millikan's empirical law:

$$eV_s(\nu) = h\,\nu - \phi,$$

we identify:

$$h_\Psi \equiv h, \qquad \phi_\Psi \equiv \phi.$$

Thus, the constant measured by Millikan is precisely the **Quarkbase ether coupling** h_Ψ.

6.3 Determination of $(\beta\alpha^2)$ from experiment

From the theoretical derivation:

$$h_\Psi = \frac{\beta\alpha^2}{4c_\Psi}.$$

Using ($c_\Psi \simeq c$) and identifying h_Ψ with the experimentally measured Planck constant h, we obtain:

$$h = \frac{\beta\alpha^2}{4c}.$$

Solving for the product $(\beta\alpha^2)$:

$$\boxed{\beta\alpha^2 = 4ch.}$$

Numerically, inserting the experimental value of h and c determines **one universal combination of ether parameters**:

$$\beta\alpha^2 = 4ch_{\text{exp}}.$$

This is the first empirical constraint on the mechanical properties of the etheric plasma derived directly from experiment: the Millikan slope fixes the product of rigidity and coupling.

6.4 Physical meaning of the calibration

This identification has a clear physical interpretation:

- Millikan's experiment does not measure "photons" in this framework.
- It measures how much **energy per cycle** a Ψ-oscillation of frequency (ν) can transfer to a surface cavity.

The result is:

$$\Delta E_{\text{cycle}} = h\nu,$$

where:

$$h = \frac{\beta\alpha^2}{4c_\Psi}.$$

Equivalently:

> The photoelectric effect is a macroscopic probe of the ether's **stiffness** and **coupling strength**, and the constant h is the macroscopic manifestation of these microscopic properties.

The universality of the slope in Millikan's data reflects the universality of (β), (α), and (c_Ψ): they are properties of the etheric plasma, not of the emitting material.

6.5 Consistency with the nuclear scale

In Section 5, matching the nuclear screening energy ($E_\Psi = \hbar c_\Psi/\lambda$) with the quarkbase compression energy ($E_q = \beta\alpha^2/(8\pi r_0)$) led to:

$$\beta\alpha^2 \approx \frac{8\pi\hbar}{c_\Psi}.$$

Combining this with the calibration:

$$\beta\alpha^2 = 4c_\Psi h,$$

gives:

$$4c_\Psi h \approx \frac{8\pi\hbar}{c_\Psi}.$$

Rewriting:

$$h \approx \frac{2\pi\hbar}{c_\Psi^2}.$$

Taking ($c_\Psi \simeq c$), one obtains ($h \approx 2\pi\hbar/c^2$). In the natural units of the theory (where $c_\Psi = 1$), this reduces to:

$$h \equiv 2\pi\hbar,$$

which is simply the standard relation between h and $\hbar$. In other words, the combination of:

- the nuclear scale (through λ and r_0),
- and the photoelectric slope (through h),

is internally consistent within the Quarkbase framework: **the same action constant governs both nuclear modes and photoelectric emission**.

6.6 Result of the calibration

After this step, the theory no has free choice for $(\beta\alpha^2)$. The product is fixed empirically by a single, historically well-established measurement. All other appearances of h in atomic spectra, black-body radiation, graphene absorbance, and other phenomena become **predictions** of the etheric-plasma mechanics, not independent postulates.

7 Universality of (h_Ψ): Hydrogen, Black-Body Radiation, Graphene, and the Photoelectric Effect

Planck's constant appears in four fundamental experimental phenomena:

1. the energy levels of hydrogen,
2. the black-body spectrum,
3. the photoelectric effect,
4. the universal absorbance of graphene.

In standard physics there is no unified explanation of why **the same number** controls such different phenomena, nor why its value is exactly the same in every case. In Quarkbase, they all arise from the same origin:

the mechanical coupling between oscillations of the etheric plasma and the quarkbase cavities.

7.1 Hydrogen: resonant cavities in the etheric plasma

In Quarkbase, the electron in hydrogen is not a point particle but a **spherical cavity** formed by 12 quarkbases floating in the etheric plasma. The nucleus is a compact cluster of quarkbases inducing a deep pressure well. Bound states appear because the electron cavity must satisfy **phase closure conditions**:

$$2kr_B = 2\pi n, \quad n \in \mathbb{Z},$$

where (r_B) is the Bohr-like radius derived from geometric and pressure balance arguments.

The energy difference between levels is:

$$\Delta E_{n\to m} = h_\Psi \, \nu_{n\to m},$$

where the transition frequency is fixed entirely by geometry and the propagation speed c_Ψ. Thus, the same h_Ψ derived earlier ensures that:

$$E_n = -\frac{h_\Psi^2}{8\beta r_0^2}\frac{1}{n^2},$$

recovering the Rydberg-like structure, where the effective Rydberg constant depends on:

- r_0 (geometry),
- β (rigidity),
- α (coupling),
- c_Ψ (propagation speed).

Result: The hydrogen spectrum uses *exactly* the same h_Ψ that appears in the photoelectric effect. This explains why spectral lines and the photoelectric slope share the same Planck constant, something that standard theory simply assumes.

7.2 Black-body radiation: Planck's law as an emergent property of the ether

Planck's law originally arose as an empirical fit. In Quarkbase:

- A cavity at temperature T contains a distribution of Ψ-modes.
- Each mode of frequency (ν) carries energy ($E = h_\Psi \nu$).
- The number of modes per unit volume follows from the standing-wave condition.
- The thermal population emerges from entropy maximization with energy linear in ν.

Putting these elements into the statistical equilibrium of the etheric plasma reproduces:

$$u(\nu, T) = \frac{8\pi\nu^2}{c_\Psi^3}\,\frac{h_\Psi \nu}{\exp(h_\Psi \nu/kT) - 1}.$$

Thus, **Planck's law is not a postulate** but a mechanical consequence of $E = h_\Psi \nu$, which itself originates in the properties of the ether.

The same constant h_Ψ fixed by Millikan determines the black-body spectrum, consistent with the experimental fact that thermal radiation uses the same h as the photoelectric effect and hydrogen. Here, for the first time, this has a unified mechanical explanation.

7.3 Graphene: universal absorbance and the quantum conductivity

In graphene experiments, the optical absorbance at normal incidence is:

$$A = \pi\alpha, \qquad A \simeq 2.3\%.$$

In standard physics, this emerges from the fine-structure constant $\alpha = e^2/(4\pi\varepsilon_0\hbar c)$, which involves h in a context apparently unrelated to spectra or black-body radiation.

In Quarkbase:

- the π-absorbance comes from the resonance of Ψ-waves with the hexagonal cavity structure,
- the effective conductivity emerges as:

$$\sigma_{\text{sheet}} = \frac{e_\Psi^2}{4h_\Psi},$$

  where e_Ψ is the quarkic coupling equivalent to electric charge.

Thus, absorbance in graphene depends directly on:

$$A = \pi\alpha_{QB} = \pi\,\frac{e_\Psi^2}{4\pi\varepsilon_\Psi h_\Psi c_\Psi},$$

and the same h_Ψ calibrated from Millikan enters **with no additional assumptions**. This explains why the universal absorbance of graphene uses the same h as:

- the photoelectric effect,
- atomic spectra,
- thermal radiation.

In the Quarkbase theory, this is not a coincidence: all of them arise from the same physical mechanism.

7.4 Photoelectric effect: the direct probe of h

The photoelectric effect measures the transfer of **one cycle** of Ψ-energy into a cavity, giving experimentally:

$$E_{\text{out}} = h\nu - \phi.$$

In the Quarkbase theory:

- A surface electron is a shallow quarkbase cavity.
- A Ψ-mode of frequency (ν) carries energy $h_\Psi\nu$.

- If the cavity's depth is ϕ_Ψ, rupture occurs when:

$$h_\Psi \nu > \phi_\Psi.$$

This reproduces Einstein's relation with:

$$h_\Psi \equiv h.$$

Thus, the photoelectric effect directly measures the universal ether constant.

7.5 Summary of universality

Every phenomenon above uses the same constant:

$$h_\Psi = \frac{\beta \alpha^2}{4 c_\Psi}.$$

And thus:

- Atomic spectra
- Electromagnetic radiation
- Graphene optics
- Photoelectric emission

share this constant because they all involve:

- the same pressure field Ψ,
- the same rigidity β,
- the same coupling α,
- the same propagation velocity c_Ψ,
- and the same geometric constraints on ether volume exclusion.

This is the first framework in which Planck's constant **has a unified mechanical and geometric origin**, rather than being a mysterious parameter introduced for convenience.

8 Discussion: Conceptual Implications and Contrast with Standard Quantum Theory

8.1 A constant without origin in standard physics

In conventional physics, the Planck constant h is introduced as an empirical proportionality factor. Neither classical electromagnetism, special relativity, nor quantum mechanics itself provides an explanation for its value or its universality.

Quantum theory *assumes*:

- $E = h\nu$ (Planck 1900),
- the quantization of oscillators (Einstein 1907),
- the canonical commutation relations $[x, p] = i\hbar$ (Heisenberg 1925),
- the action quantization in semiclassical models.

But no mechanism explains *why* the same constant controls:

- atomic energy levels,
- black-body radiation,
- photoelectric slopes,
- graphene's minimum conductivity,
- superconducting flux quanta,
- de Broglie wavelengths,
- and the structure of Heisenberg's algebra.

Standard theory unifies these phenomena formally, but not physically: **h is a postulate, not a prediction.**

8.2 The Quarkbase alternative: a mechanical origin for h

In Quarkbase Cosmology, the vacuum is replaced by a **frictionless compressed medium** (the etheric plasma), and matter is formed by **geometric quarkbase cavities** that impose boundary conditions on the field.

In this framework, h_Ψ emerges from:

- the rigidity of the ether (β),
- the displaced-volume coupling (α),
- the propagation speed of the Ψ-field (c_Ψ),
- and the apantallamiento geometry ($\lambda \approx r_0$ at nuclear densities).

The constant of proportionality between energy and frequency appears not as a quantization axiom but as:

> **the mechanical cost of deforming the ether around a cavity through one oscillation cycle.**

This is fundamentally different from the quantum-postulate interpretation. Here, discreteness arises from **geometry + elasticity**, not from "quantization rules".

8.3 Universality explained

Because h_Ψ depends only on the fundamental properties of the medium, not on the material emitting or absorbing radiation, the universality of Planck's constant is immediate.

This resolves one of the oldest puzzles of modern physics:

> Why does *every* frequency mode, in *every* material, in *every* experiment, carry energy proportional to ν with the *same* constant?

In Quarkbase:

- All Ψ-modes live in the same ether,
- All cavities displace the same volume locally,
- All interactions use the same boundary conditions,
- All processes involve the same stiffness and coupling.

Thus:

> **A single mechanical constant must appear everywhere.**

Quantum mechanics accepts this universality; Quarkbase *explains* it.

8.4 The "quantum" as a geometric unit of ether deformation

In the standard view:

- A quantum is a discrete unit of energy carried by a photon.

In Quarkbase:

- No photons exist as particles.
- The "quantum" is the **minimum cycle of ether deformation** that a cavity must absorb or emit.

This cycle cannot be subdivided because:

- the cavity must absorb a full oscillation to preserve boundary conditions,
- the medium cannot deliver a fractional pressure wave with stable phase,
- global volume conservation of the ether requires integer cycles.

Thus:

> **Quantization is a property of geometry and elasticity, not of the electromagnetic field being "particle-like".**

This reframes quantum discreteness as **continuum mechanics**, not particle physics.

8.5 Relation to Heisenberg uncertainty

In standard physics:

$$\Delta x \, \Delta p \geq \frac{\hbar}{2}$$

is fundamental and postulated through operator algebra.
In Quarkbase, it emerges as a **kinematic relationship** between:

- the spatial extent of a cavity deformation,
- and the momentum flux required to sustain a phase-coherent Ψ-wave over that region.

In other words:

- A smaller cavity requires steeper gradients of Ψ,
- which implies larger energy flux,
- which implies larger "momentum density" of the medium.

Thus, the uncertainty principle emerges from:

the finite rigidity of the ether and the phase coherence constraints.

Not as a quantum axiom, but as continuum field behaviour.

8.6 Revisiting the photon: wave without particle

In conventional physics, the photon is:

- particle-like (quantized energy),
- massless,
- localizable only probabilistically.

In Quarkbase:

- there are no photons,
- only oscillations of the Ψ-field of the ether,
- whose energy is linear in frequency because of the medium's stiffness.

This solves several conceptual tensions:

- No wave–particle duality.
- No need for a nonlocal collapse mechanism.
- No incompatibility between continuous wave propagation and discrete detection.
- The nonlocal statistical correlations (entanglement) arise naturally from coherent field configurations, not from "spooky action".

The photon is replaced by **a mode of the medium**.

8.7 Conceptual synthesis

The emergence of h_Ψ from ether mechanics unifies:

- electromagnetism,
- quantum phenomena,
- nuclear structure,
- material optics (graphene),

under a single principle:

> **Oscillations of a frictionless etheric plasma store and transmit energy in direct proportion to frequency, with a constant of proportionality fixed by the medium's rigidity and coupling.**

This is the physical origin of h. The quantum is not a property of matter— **it is a property of space as a mechanical medium.**

9 Conclusion

Planck's constant, introduced in 1900 as an empirical fitting parameter and elevated in quantum theory to a fundamental postulate, has remained without a mechanical explanation for more than a century. In this work we have shown that h arises naturally within the framework of Quarkbase Cosmology, where the vacuum is replaced by a frictionless etheric plasma governed by the pressure field $\Psi(x,t)$, and matter consists of geometric quarkbase cavities that displace finite volumes of the medium.

By analyzing the energy stored in oscillatory modes of the ether and their interaction with displaced-volume cavities, we have derived the universal relation:

$$E = h_\Psi \nu, \qquad h_\Psi = \frac{\beta\alpha^2}{4c_\Psi},$$

linking the energy of a mode to its frequency. This constant emerges solely from:

- the stiffness (β) of the etheric plasma,
- the source–field coupling (α),
- the wave-propagation speed (c_Ψ),
- and the geometric scale of quarkbases.

We showed that the apantallamiento length ($\lambda \approx r_0$) at nuclear densities fixes the natural energy scale ($E_\Psi = \hbar c_\Psi/\lambda$), and that equating this to the quarkbase compression energy determines h_Ψ up to a universal factor. When the result is calibrated using Millikan's 1916 photoelectric measurements, the numerical value of the Planck constant is reproduced and the product ($\beta\alpha^2$) is empirically determined.

The universality of h in phenomena as diverse as atomic spectra, black-body radiation, photoelectric emission, and the optical response of graphene is no longer a coincidence: it reflects the universality of the etheric plasma. Consequently, the discreteness observed in quantum mechanics is not a fundamental axiom but a geometric and mechanical consequence of how oscillatory modes interact with cavities in a continuous medium.

This interpretation provides a unified mechanical foundation for quantum behaviour while preserving relativistic invariance and the wave nature of the field. It also opens a pathway toward re-expressing quantum phenomena as emergent properties of a single classical medium, offering new insight into the nature of energy, radiation, and the underlying structure of physical law.

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